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ABSTRACT

The Delaplaine Agriculture Department Confinement Project, begun in June 1988, conducted a confinement aquaculture program by comparing the growth of channel catfish raised in cages in a pond to channel catfish raised in cages in the Black River, Arkansas. The study developed technology that would decrease costs in the domestication of fish, using existing resources such as abundant lakes and rivers to increase food production, with a high volume alternative to the dietary market. The purpose of the project was to initiate a program that would provide vocational teachers and students with an opportunity to improve their competencies through structured, hands-on experiences. It was found that catfish can be raised successfully in a cage in a river; up to 98 percent of fish in pens survive. The feed-to-fish conversion ratio was not accurately determined because of feeding "phantom fish"--net pens suffered large holes that allowed catfish to escape. The average daily rate of weight gain in cycle one was .0019 and in cycle two, .0020. Catfish can be successfully overwintered in cages in ponds and rivers. (NLA)

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FINAL REPORT

CONTINUATION ACTIVITIES

Conducted by

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In Cooperation With

Vocational and Technical Educational Division
Arkansas Department of Education
Little Rock, Arkansas 72201

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

INTRODUCTION: While farm animals have been domesticated for thousands of years, only recently has man become successful in domesticating large numbers of fish. Confinement Aquaculture is the method of raising fish, clams, mussel, etc, in submerged cages, pens, or shelves. The Delaplaine Agriculture Department Confinement Project, begun in June 1988, compared the growth of channel catfish raised in cages in a pond to channel catfish raised in cages in Black River. The motivating idea behind this study was to develop technology that would decrease costs in the domestication of fish using existing resources such as abundant lakes and rivers to increase food production with a high volume alternative to the dietary market.

OBJECTIVES: The purpose of this project was to initiate a confinement aquaculture program that would provide vocational teachers and students with an opportunity to improve their competencies through structured, hands-on experiences. The objectives of this project include: (1) increasing the number of local farmers interested in confinement aquaculture, (2) providing students hands-on experience by feeding, stocking, cleaning, harvesting, and managing a lab necessary for raising caged fish as part of a supervised occupational experience project, (3) comparing cage farming in a river to cage farming in a pond, and (4) comparing varieties of feed in the same pond.

PROCEDURE: The Delaplaine project consisted of ten net pens: five in Black River and five in a pond in Greene County. Four net pens at each location were located inside a floating dock. One net pen at each location was not inside the floating dock.

The docks were made of 16 gauge, 1" x 3" steel tubing with expanded steel for flooring. Each dock floated on 12" thick styrofoam. The dock at Black River had a steel structure underneath for protection from floating debris. Walkways from the shore line were also provided.

The net part of the pens was constructed from plastic mesh with 3/4" openings. A 1" x 3" 16 gauge tube steel top frame was covered with expanded steel. Steel rods were used for a bottom frame for the five Black River pens. The pens in the pond had no bottom frames. The size of the river pens was 4' x 4'x5', while size used in the pond was 4' x 4' x 4'. The pens were laced together with nylon line. Knots were used every 6" to prevent unraveling of the net in case of a failure. The top frame fit inside the dock from the top, allowing each to be locked and allowing walking on top of the net pen. The docks, with net pens in place, were anchored by steel cables and 2" steel pipes.

The Arkansas Game and Fish Commission provided channel catfish which were eventually harvested and stocked in Lake Ashbough, an Arkansas Game and Fish lake. All fish originated from the same brood ponds. Year one average

stocking weight, .09 lbs., year two average stocking weight .08 lbs. Size was approximately 6" average length. Smaller stock was not used because it could have escaped through the plastic mesh.

Daily feeding was done by hand from stocking time until water temperatures dropped (Nov-Dec), which caused feeding to slow down. Fish were checked visually every day for signs of problems. Any death loss was recorded. Fish which were overwintered were fed and checked two days per week during the winter. Little active feeding was observed during winter. Feeding was approximately 3-6 % of body weight, based on a random weight sample from the net pen. Adjustments were made in the amount of feed as the weight of the fish in the pen increased. The catfish were fed a special ration prepared for the Arkansas Game and Fish Commission. (Appendix 1) Floating feed was unavailable at the beginning of the trial. It was later used exclusively. In both locations the sinking feed was unsatisfactory because it did not allow the fish enough time to eat before it passed through the bottom of the pen. For containment of feed, an 18" plastic mesh feeding ring was hot glued to the inside top 18" of each net pen. This allowed the feed to stay in the pen long enough to be consumed by the fish in that pen.

Additional pens at each location were placed outside the pen to compare with the four pens in each dock.

The second year two PVC pipe and nylon net pens were built to determine how they would compare to the steel and plastic pens. Also, because of the number of fish lost the first year in the pond due to oxygen problems, an Otterbrine Little Titan 1/5 Hp aerator was installed on the walkway leading to the dock. It was in operation 24 hours a day during periods of low oxygen and hot weather. The aeration in the pond stopped any further problems of loss due to low oxygen.

EVALUATION: The immediate success of the project was evaluated by the following questions:

1. Can catfish be raised in a cage in a river?
2. What percent of fish in pens survive?
3. What is the feed-to-fish conversion ratio?
4. What is the average daily rate of weight gain?
5. Can catfish be overwintered in cages in pond and rivers.

1) The results of the study indicate that catfish can be raised in cages in rivers as well as in ponds. Stress induced by changes in water level, flow rate and turbulency do add to the problem of raising fish in a river, but no oxygen problems were encountered in the river.

2) The survival rate per pen varied from 2% to 98%. Many factors had an effect on this variation,including: water quality, temperature, oxygen content, diseases induced by stress, parasite problems, and poor management.

3) The feed conversion ratio was not accurately determined because of feeding "phantom fish". Three net pens suffered large holes in the plastic mesh or had a seam failure. These problems allowed a total of about 1000 catfish to escape into the pond and river. The escape was undetected for some time, and the fish pens were fed even though few fish were present.

4) The average daily gain for the project was as follows. (all weights in pounds).

	CYCLE 1	CYCLE 2
Initial weight	.09	.08
Final weight	.41	.44
Average daily gain	.0019	.0020

Average daily gain based on 165 day growing cycle. These figures do not reflect the catfish which were overwintered. (Based on average starting and ending weights)

5) Catfish can be overwintered in a net pen in a pond as well as in a river. There was a small average weight loss in fish in the river over the winter, possibly due to the energy loss because of river current. The only noted loss was a temperature shock problem in Black River. The air temperature dropped from 60 degrees F to 3 degrees F in 12 hours. Two days later dead fish were found.

The net pens were stocked on June 20, 1988 for the first time. The first CYCLE of fish was harvested from November 22, 1988 to December 22, 1988. The pond average weight for CYCLE 1 was .27 lbs. The average river weight for CYCLE 1 was .29 lbs. Seven hundred fish in the pond and 600 fish in the river were overwintered. The CYCLE 1 survival rate was 44% for the pond and 38% for the river. The total number of catfish released in Lake Ashbough in 1988 was 1745. A net pen failure released 300 catfish into the Black River. Two-hundred-seventy-eight river catfish survived the winter while 691 pond catfish survived the winter. Pond death loss was 1.5% compared to a river death loss of 12% based on the number found dead in the pens.

For CYCLE 2 the net pens were cleaned and restocked 31, 1989, and they were harvested October 13, 1989 to December 14, 1989. The pond average weight for CYCLE 2 was .34 lbs. The river average weight for CYCLE 2 was .37 lbs. The overwintered fish weight averaged: river .98 lbs pond .91 lbs. The pond and river survival rate for CYCLE 2 stood exactly the same at 94% The total number of catfish stocked in Lake Ashbough from October 3, 1989 to December 14, 1989, was 2883. Survival rates were based on the number of dead fish found in each pen. Three river pens had large holes from logs allowing a total of 464 fish to escape into Black River during the CYCLE 2 operation.

The success of the confinement aquaculture project can be measured many different ways. The greatest success of this project has been to create public interest in confinement aquaculture practices. Inquiries for information have been received from ten states. The project has been featured on two television programs. National Future Farmers Magazine featured the project. more than a dozen feature newspaper articles brought this project to the public eye in Northeast Arkansas. The Delaplaine Aquaculture Program was the first of its kind in an Arkansas High School. Other schools have now begun to offer aquaculture classes. Delaplaine High school is being considered for one of five pilot schools in the U.S. for testing an aquaculture curriculum which is being produced by the council. A resource list of companies and individuals has been produced. (See appendix number 3). Plans for a simple net pen and for the Delaplaine net pen dock are also presented. (See appendix number 2) Public information booths have been provided at fairs. A guided tour for agriculture instructors has been given of the DHS site and of three other aquaculture operations. DHS hosted 70 people at a field day for farmers and other interested individuals. The field day consisted of demonstrations, visits to the net pens and a display of resource information.

CONCLUSIONS: The wave of agriculture is aquaculture. Annual world aquaculture production has increased dramatically in recent years and will continue to do so for the next several decades. Fishery landings have leveled off while demand for fish products has increased. The difference will be made up from aquaculture. Many aquaculture operations now exist in locations with no real alternative use,lowlands or swamps. As world population increases it will demand the use of land for houses and roads, not ponds. A net pen operation is an alternative aquaculture use which will allow increased production without increased use of land. **The real advantage to net pens or cages is that they allow fish to be grown and harvested easily in places where they could not otherwise be managed.** Large bodies of water, streams, highway ponds, lakes with timber, and irrigation raceways are only some of the possible locations for net pens. Any arrangement must be made with water quality, environme..., local, state and federal government considerations in mind. Laws governing net pen placement vary from state to state.

The Delaplaine Confinement Aquaculture Project made the following observations:

1) Channel catfish can be raised in a river as well as in a pond.
2) Channel catfish in Arkansas Will survive overwintering in a net pen.

3) Feed conversion for net pen fish is not as good as for fish in pond.

4) Good management (close observation) must be in practice to avoid unacceptable losses. Early detection and treatment of diseases are a must. Treatment of water as well as treatment of feed worked.

5) PVC pipe frames outside the net with treated nylon net holds up better than frames with plastic nets. Plastic mesh will tear if it is not handled carefully.

6) More organic buildup takes place on the nylon net than on the plastic mesh.

7) Feed rings attached onto the outside of the net pen were effective in keeping feed in, both in the river and in the pond. It also trapped floating debris in the river which had to be cleaned out. A small feed ring in the center worked better.

8) Disturbing (handling, weighing, showing off) fish should be kept to a minimum.

9) Site selection is very important for placement of pens.

    A) Ponds need four or more feet of water under the net pen to avoid toxin problems.

    B) River placement should be in location with good water exchange but little current

flow. The Delaplaine Black River pens had too much current flow. Consideration must be taken for rising and falling water levels.

10) The small individual pens had better survival rates and growth rates than the pens which were placed together. Movement restrictions inside the dock may have accounted for the smaller numbers in the latter group. If small pens are used, space for water movement needs to be allowed.

11) A dock with pens on the outside would be better suited for production than the arrangement at DHS.

In summary, large numbers of fish can be raised in a minimum of space in a net pen. Water quality and good management go hand-in-hand to make a net pen operation successful. Small or large net pens offer a practical alternative aquaculture enterprise. Net pen culture is adaptable to many other fish. The catfish condo concept can work.

The Delaplaine Agriculture Department would like to express it's thanks to the Arkansas Game and Fish Commission for all its hard work and support, without which it would have been impossible to complete this project. Also, the state Vo-Tech Division Planning and Development Staff helped tremendously.

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Bassett, Barbara, "Raising Catfish in Floating Cages", Manual Y928, Extension Publication, 115 South 5th St., Columbia, MO 65211.

Collins, Richard, "Cage Culture of Catfish in Reservoir Lakes", State College of Arkansas, Conway Arkansas.

Gray, D. Leroy, "Arkansas Aquafarming", Extension Fisheries Specialist, Box 391, Little Rock, AR 72203.

Gray, Leroy, & Newton, Scott, "Catfish Cage Culture in Farm Ponds", E1659, Cooperative Extension Service, University of Arkansas Pine Bluff, Pine Bluff AR.

Lee, Jasper, Commercial Catfish Farming , The Interstate, Printers and Publishers, Inc. Danville, IL.

Macurdy, Haile, "Annual Catfish Program Completion Reports, Bull Shoals Net Pen Operations", Arkansas Game and Fish, P.O. Box 178 Lonoke, AR 72086.

Schnick, Rosalie A., Meyer, Fred, Gray, Leroy, "A Guide to Approved Chemicals in Fish Production and Fishery Resource Management", Cooperative Extension Services, University of Arkansas, P.O. Box 391, Little Rock, AR 72203.

APPENDIX #1

Catfish Feed Used in Delaplaine

SFA Southern Farmers Association

Grow Big Floater (Medicated) DBL

Active Drug	
Sulfadimethoxie	42%
Ormetoprim	.084%
Analysis	
Protein	32%
Fat	2.5%
Fiber	7%
Moisture	12%

Arkansas Game and Fish Commission

SFA Southern Farmers Association

Protein	35%
Fat	2.5%
Fiber	7%
Moisture	12%

APPENDIX #1

Formula AGF-2

Extruded Pellet - Semi-Floater
Net Pen Culture - Catfish

Ingredient	%	Pounds/Ton	% Protein	% Fat
Fish Meal, Menhaden (61.1% Protein, 9.7% Fat)	15.0	300	9.2	1.45
Soybean Seeds, w/o hulls Solvent Extracted (48.8% Protein, 1% Fat)	40.0	800	19.52	0.40
Wheat Middlings, Lt 9.5% Fiber (16.7% Protein, 4.6% Fat)	8.3	165	1.39	0.38
Rice Bran, w/germ (12.7% Protein, 13.9% Fat)	5.0	100	0.64	0.70
Corn, Yellow Dent, Grain* (9.6% Protein, 3.9% Fat)	25.0	500	2.40	0.98
Sorghum (Milo), Grain* (11.3% Protein, 2,8% Fat)	25.0	500	2.83	0.70
Dicalcium Phosphate	1.0	20	----	----
Vitamin & Mineral Premix**	0.7	15	----	----
Fat, Chicken, Stabilized***	5.0	100	----	5.0
Total	100.0	2,000	33.15 (Corn)	8.91
			33.58 (Sorghum)	8.63

*Either can be used.
**See Vitamin and Mineral Premix page.
***Fat added as a top dressing at the end of the extrusion process.

Arkansas Game and Fish Formula-2

APPENDIX #1

Vitamin and Mineral Premix

Vitamin	(1X) Formula AGF-1 Quantities/Ton	(2X) Formula AGF-2 Quantities/Ton
Vitamin A activity	4,950,000 IU	9,900,000 IU
Vitamin D_3 activity	900,000 IU	1,800,000 IU
Vitamin E	45,000 IU	90,000 IU
Vitamin K	9.9 g	19 g
Choline	495.9 g	990 g
Niacin	90.0 g	180 g
Riboflavin	18.0 g	36 g
Pyridoxine	18.0 g	36 g
Thiamin	18.0 g	36 g
D-calcium panthothenate	45.0 g	90 g
Biotin	90.0 g	180 g
Folacin	4.5 g	9 g
Vitamin B-12	18.0 g	36 g
Ascorbic Acid	90.0 g	180 g
Inositol	90.0 g	180 g

Mineral Mix - Formula AGF-1 and AGF-2

A mineral mixture suitable for intensively produced chickens can be used.

Arkansas Game and Fish

APPENDIX #2

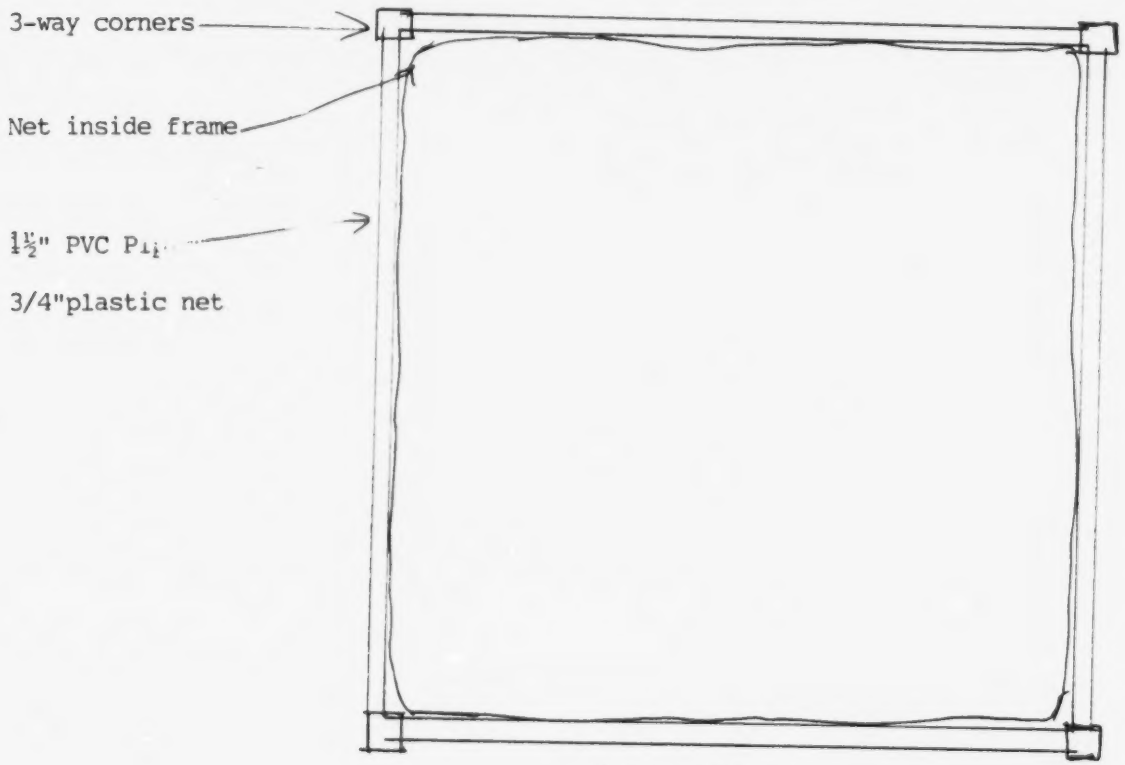
SIMPLE NETPEN

Using three way tees, and 1½" PVC Pipe construct frame 48"X48"X48".
Dry fit all parts together and measure to assure a good fit.
Glue all parts together.

If plastic mesh is used it comes in a 48" wide roll, 50' long. Plastic mesh size 3/4".
Start the netpen inside the plastic frame, by going around the inside with the plastic mesh. Attach at the corners with nylon ties or twine. Weave together the ends of the mesh. The sides will only have one seam. Insert the bottom in the cage and weave into place.

A top can be made from ½" PVC and 4 elbows and covered with plastic mesh.

A feed ring of ¼" plastic mesh can be suspended from the top. This ring will contain the feed to prevent waste. When the top is lifted the feed ring is self cleaning.



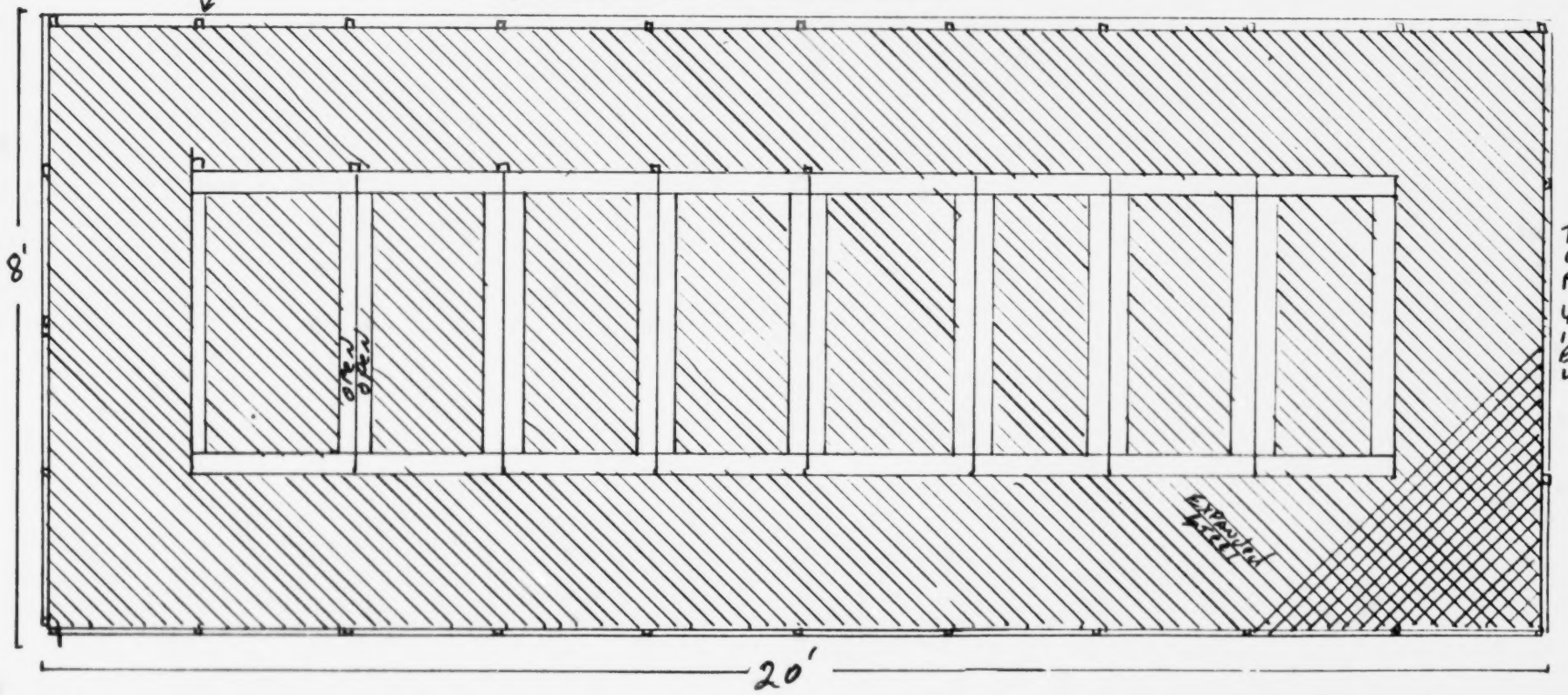
not to scale

Float by using 4 plastic buckets at the corners.
This pen will accommodate 400 fingerling catfish. Larger Pens will handle more fish.

DeLaPlaine Net Pen Dock

4 Pens 4'X4'X4' 400 Fish Each Lift From Top

NOT TO SCALE



APPENDIX #2

APPENDIX #3

Delaplaine Aquaculture

Sources for Information

Net and Twine

Memphis Net and Twine Co. Inc.
2481 Matthews Ave.
P.O. Box 8331
Memphis, TN 38101
1-800-238-6380

Nylon Net Company
615 E Bodley Ave.
P.O. Box 592
Memphis, TN 38101
(901) 774-1500

Inter Net Inc.
Plastic Netting Fabrication & sale
2730 Nevada Ave.N.
Mpls, MN 55427
1-800-328-8456

J.A. Cissel Co.
P.O.Box 339
Farmingdale, NJ 07727
(800) 631-2234

Reed's Net Co.
Highway 49 West
p.o. Box 194
Belzoni,MS 39038
(601) 247-4827

Zapata Net
P.O. Box 175
Reedville, VA 22539
804-453-4211

Arkansas Fish and farm Supply
115 South Center
Lonoke, AR 72086
(501) 676-6564

Delta Net and Twine Co.
P.O. Box 356
Greenville, MS 38701
(601) 332-0841

Aerators/Agitators

Fritz Aquaculture
P.O. Drawer 17040
Dallas, TX 75217

Air-O-Lator
Sales Office/Plant/Service Center
8100-04 Paseo
Kansas city, MO 64131
1-800-821-3177

Aquatic Eco-Systems,Inc.
P.O. Box 1446
Apopka, FL 32704

Commerce Welding and
Manufacturing Co., Inc.
2200 Evanston
Dallas, TX 75208
1-800-527-5798

Rainbow Plastics Filter Division
3242 Meeker Avenue
P.O. Box 4127
El Monte, CA 91734
(818) 443-6114

Airco
Commercial Development
575 Mountain Avenue
Murray Hill, NJ 07974

AIS America, Inc.
200 South Fourth Street
P.O. Box 520
Geneva, Illinois 60134
708-232-6438

ENTEK Corporation
P.O. Box 879
Grapevine, TX 76051
(817) 481-5588

APPENDIX #3

Holding/Culture Tanks

Solar Components Corp.
88 Pine Street Dept. AQ
Manchester, NH 03103
800-258-3072

Harvey's Fiberglass, Inc.
114 S. Grand
Brinkley, AR 72021
(501) 734-3566

AFS
Aquafarm Systems Inc
7e 17th Street
St.Cloud, FL 32769

Rowland Fiberglass Inc.
P.O. Box 971
Ingleside, TX 78362

Duracraft
Hwy. 4 West
Monticello, AR 71655

Red Ewald, Inc.
P.O. Box 519
Karnes City, TX 78118
(512) 780-3304

Netpen
C.E. Shepherd Co. Inc.
2221 Canada Dry Street
P.O. Box 9445
Houston, TX 77261-9445
1-800-231-9562

Inqua Corporation
Box 86
Dobbs Ferry, NY 10522
(212) 840-3333 or (914) 693-6186

Neltex Netting
203 Colorado
Austin, TX 78703
(800) 426-6258

Fish/Feed Supplies

Anderson Bait Dist.
P.O. Drawer 290
Lonoke, AR 72086
(501) 676-3166

Eagar Inc.
P.O. Box 476
North Salt Lake, Utah 84054
800-444-1484

Industrial Grain Products, Inc.
P.O. Box 3520
Lubbock, TX 79452
800-444-1484

Farmboy's Industries, Inc.
P.O. Box 326
Swifton, AR 72471
501-485-2400

Arkansas Aquatics
Keo Fish Farm
P.O. Box 123
Highway 165 N.
Keo, AR 72083
(501) 842-2872

Kueter's Lake Inc.
Rt. 6 Box 339
Paragould, AR 72450

Coldstream Fisheries Inc.
Rt. 6 Box 86
Paragould, AR 72450
501-236-2517

The Redfish Hatchery Inc.
23707 Redfish Lane
PassChristian, MS 39571
(601) 452-2034

Van E. Pennington
Extension Fishery Spec.
P.O. Box 230
McGehee, AR 71654
501-222-3972

APPENDIX #3

Technical

AMOX Division VBM Corporation
P.O. Box 922
Louisville, KY 40201
(800) 451-3027

Aquaculture & Biotech
Solar Components Corp.
88 Pine Street
Manchester, NH 03103

Data Lynx Instruments
P.O. Box 240
Grass Valley, CA 95945
(916) 477-5226

Acry-tec
7352 Trade Street
San Diego, CA 92121
1-800-422-7983

MISC.

Aquaculture
P.O. Box 2329
Asheville, NC 28802
(704) 254-7334

Aquaculture Resources Guide
The Council
P. O. Box 15035
5632 Mt. Vernon Mem. Hwy.
Alexandria, Va 22309-0035
(703) 360-8832

Commercial Fisheries News
Product News
Wheelhouse Building,634 Village Lane North
Suite 204 Mandeville, Louisiana 70448
(504) 626-7990

Ketchum Manufacturing Sales LTD.
396 Berkley Ave.
Ottawa, CAnada
(613) 722-3451

Kentucky State University
James Tidwell, Ph.D.
Aquaculture Research
Frankfort, Kentucky 40601
(502) 227-6925

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